Weather Risk Management in Tourism Industry*

Simona Franzoni[**], *Cristian Pelizzari*[***]

Abstract

Globalisation, climate change, the global economic crisis, and the increasing political instability have multiplied the risk factors in the tourism industry. Climate change, in particular the variability of weather, hevily affects decision-making in the tourism industry. Indeed, tourism can be considered a highly weather-sensitive economic sector, but, at the same time, the tourism industry has a key role to play in dealing with the challenges of climate change.

For their own survival, tourism firms should adopt actions aimed at promoting a risk reduction through urgent measures designed to combat climate change (reduction of energy consumption, switching to renewable energy sources, etc.). On the other hand, they should enable complementary interventions to share weather risks: from "accessory services", such as tasting events, sport activities, wellness centers, which promote tourism attractiveness safeguarding territory sustainability, to rainfall derivatives, which are designed to protect tourism firms from excessive rainfall.

Keywords: Climate Change; Global Tourism; Tourism Sustainability; Risk Management; Weather Risks; Rainfall Derivatives

1. Climate Change and Global Tourism

The primary role of the tourism industry in thenational and international economies, the evolving features of the tourism market, the sudden changes in habits and expectations of tourists, and the changes in the mix of production factors used by the tourism industry identify only some of the phenomena that led to emphasize the importance of a more conscious, rational, and finalized management of tourism firms.

Moreover, the dependence on uncontrollable or only partially controllable external factors is a significant phenomenon in this sector, where the reference environment appears extremely broad and articulated, since it is influenced by natural, economic, social, cultural, and political variables, both at a national and at an international level.

* The Authors: S. Franzoni §§ 1,2,3, and 5; C. Pelizzari §§ 3,4, and 5
** Associate Professor of Business Administration and Accounting Studies, University of Brescia (simona.franzoni@unibs.it)
*** Assistant Professor of Mathematical Methods of Economics, Finance and Actuarial Sciences, University of Brescia (cristian.pelizzari@unibs.it)

Edited by: ISTEI – *University of Milan-Bicocca* ISSN: 1593-0319

Franzoni Simona, Pelizzari Cristian (2016) Weather Risk Management in Tourism Industry, Symphonya. Emerging Issues in Management (symphonya.unimib.it), n. 1, pp. 45-55.

http://dx.doi.org/10.4468/2016.1.05franzoni.pelizzari

In this regard, it suffices to consider the consequences of fluctuating weather conditions, of air, water, and soil pollution, of exchange rate dynamics, of a country political stability, and of demand elasticity with respect to income to understand how stochastic tourism flows, and the corresponding tourism demand, could be.

In particular, climate change heavily affects decision-making in the tourism industry (Simpson et al., 2008): temperatures are rising, rainfall regimes are changing, glaciers and snow are melting, and the average global sea level is rising. It is expected that these changes will continue and that extreme weather events such as floods and droughts will become more and more frequent and intense. A recent study by the European Commission (Barrios & Ibañez, 2015), which analysed the long-term effects on tourism caused by climate change in terms of duration and frequency of holidays, shows that by 2100 a number of tourism destinations located in the southern Mediterranean could suffer a sharp slowdown in economic activity closely related to the decline of tourism flows.

Tourism can be considered a highly weather-sensitive economic sector, similarly to the agricultural, energy, and transport sectors. Weather is a fundamental resource for tourism, in particular for the beach, nature, and winter sport segment, since it is an essential driver of global seasonality in tourism demand. The variability of weather at tourism destinations can significantly affect the comfort of tourists and their travel decisions. The variable patterns of tourism flows and of the corresponding tourism demand will have impacts on tourism firms and on host communities, as well as knock off effects on related sectors, such as agriculture, handicrafts, and construction (UNWTO, 2015).

Climate change has an important influence not only on revenues but also on operating costs, such as heating-cooling, snowmaking, irrigation, food and water supply, and insurance. Therefore, changes in the length and quality of weather-dependent tourism seasons could have considerable implications for the profitability of tourism firms (Simpson et al., 2008).

At the same time, the tourism industry has a key role to play in dealing with the challenges of climate change. The tourism industry can be part of the solution by reducing its greenhouse gas emissions, as well as by helping the communities where tourism represents a major economic source to prepare for and adapt to the changing climate.

The World Tourism Organization recognizes that tourism has the potential to contribute to all the 17 Sustainable Development Goals according to 2030 Agenda for Sustainable Development (United Nations, 2015). In particular, tourism has been included as a target in Goal 13 “Take urgent action to combat climate change and its impacts”, as well as in Goal 8, Goal 12, and Goal 14, respectively “Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all”, “Ensure sustainable consumption and production patterns”, and “Conserve and sustainably use the oceans, seas and marine resources for sustainable development”.

> *Goal 13. “Take urgent action to combat climate change and its impacts. Tourism contributes to and is affected by climate change. It is, therefore, in the sector’s own interest to play a leading role in the global response to climate change. By lowering energy consumption and shifting to renewable energy sources, especially in the transport and*

accommodation sector, tourism can help tackle one of the most pressing challenges of our time." (UNWTO, 2015).

In summary, the tourism phenomenon need to be properly managed in order to generate lasting sustainable value (Njoroge, 2015): tourism has a systemic impact, since it tends to affect the whole economy of the territory where it occurs (Leiper, 1990), impacting on the social, environmental, and economic development of the area (Franzoni, 2015). Therefore, a proper management of tourism firms is relevant for sustainable development to the goal of achieving a fair balance between economic growth and consumption of natural resources, to the final purpose of a better quality of life.

In this context, tourism firms play an important role, given the potential conflict between economic and sustainability goals that characterize all the agents of the tourism industry. Each tourism firm should adopt a management approach aimed at increasing the potential of creation of sustainable value, the exploitation of opportunities, and the management of risks, both internal and external, both preventable and non-preventable, to obtain effective economic, social, and environmental performances.

2. Integrated Risk Management and Tourism Sustainability

The environment described in the previous section, and characterized by instability and turbulence, implies that significant changes in the key factors driving a firm to success need to be analysed promptly to the purpose of ensuring a strict and lasting coherence between the system of corporate objectives and the variables that influence both sustainable development and the capacity/ability to create value (Spangenberg & Bonniot, 1998; Brondoni, 2014).

Competitive markets bring increasing risks/opportunities and challenges to firms (Brondoni, 2009). In particular, firms are faced with an undoubtedly changed the set of risks/opportunities, which require the adoption of an integrated, fast, and transparent procedure to identify, assess, manage, and monitor them. In this regard, the qualitative and management features of risks generated a first classification in macro-categories, depending on their internal or external origin (Salvioni, 2012).

The internal risk factors arise from decisions about the structure and functionality of a firm. In particular, such risks depend primarily on the behaviour coherence of the management, the corporate culture maturity, the management effectiveness and efficiency (for example, the tourism destination where the firm operates, the selection of the supply market, the flexibility of supply agreements, the management of employees, the rigidity of the cost structure, etc.).

The external risk factors originate from general economic phenomena (for example, the emergence of inflation and unemployment, the increased variability of exchange rates, the change of conditions for borrowing capital, etc.), political relationships between Countries, the political instability, speculative behaviours by investors, climate change, etc.

Based on their predictability and management features, the internal and external risks can be grouped into three categories (Kaplan & Mikes, 2012):

- Preventable risks, which arise from phenomena within the organisation and are generally controllable. Examples of such risks include risks resulting from unauthorized, illegal, or unethical actions by employees and managers and risks resulting from inefficiencies of routine work processes. A well-managed firm is oriented to the anticipation of such risks and the reduction of their likelihood of occurrence.
- Strategic risks, arising from the development of guidelines aimed at increasing the potential for success. For example, many firms take risks when doing research and development activities. This category of risks is strongly influenced by the risk appetite of managers, given that, in general, the riskier strategies are also those that offer a better potential for competitive and economic advantages.
- External risks, related to events that are external to the life of a firm and firms have a very little ability to influence and control. For example, such risks depend on major macroeconomic changes, natural disasters, and political upheavals. This case refers to events that affect the business dynamics, and allow for a very little possibility of intervention.

A timely risk management of tourism firms requires the consideration of the three above-mentioned categories of risks, with an integrated approach aimed at limiting their negative impacts on achieving conditions of economic, social, and environmental success. Firms are encouraged to adapt their processes to the three different types of risk, in order to: anticipate and mitigate the impact of external risks on the business strategy and results, maximize the success of the business strategy with respect to the risk profile that is deemed acceptable for the firm, and reduce to a minimum the impact of preventable risks.

One of the most worldwide well-known reference models of risk management is the Enterprise Risk Management - Integrated Framework, published in 2004 by the COSO, which stands for Committee of Sponsoring Organizations of the Treadway Commission (see, for example, Ballou & Heitger, 2005; Bowling & Rieger, 2005a, 2005b; Quinn, 2006; Moeller, 2007; Landsittel & Rittenberg, 2010; Salvioni & Astori, 2013). The document is based on a wide definition of Enterprise Risk Management (ERM), suitable for any organisation, private or public, operating in any sector. According to COSO, "Enterprise risk management is a process, effected by an entity's board of directors, management and other personnel, applied in strategy setting and across the enterprise, designed to identify potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives." (COSO, 2004).

The view of risk as an element that originates from the interconnections between a firm and its environment takes on an even greater importance at a time when risk management comes into close relationship with the concept of sustainability. "Sustainability can, and should, be integrated into [the components of the COSO ERM Framework.] … Incorporating sustainability considerations broadens the range of possible risks that can impact organizational objectives." (Faris et al., 2013). Because sustainability concerns extend beyond economic impacts, organizations need to evaluate all risk exposures relative to potential sustainability issues. Therefore, the analysis of the potential impacts of risks should not be limited to the economic dimension of a firm, but it should encompass also the social and environmental dimensions.

The effectiveness of a risk management framework strictly depends on the ability to identify risks and opportunities, i.e. the factors affecting negatively and positively the implementation of strategies and the achievement of objectives. Since such factors are uncertain and systemic (due to the interdependence between firms and their environment), their identification and evaluation can be complex, in particular with respect to their probability of occurrence and the intensity of their impact on sustainable performances. Subsequently, when confronted with a certain risk, a firm searches for solutions to:

- accept: no action is taken to affect the likelihood and impact of the risk;
- avoid: the activities undertaken bring about risks (for example, refusing to enter into new markets);
- reduce: actions are taken to reduce the probability of occurrence and the impact of the risk (this response is typical of many operational decisions);
- share risks with counterparties through insurance contracts, derivative instruments, and outsourcing of business processes.

The growth of the firm value depends on the ability to identify resources and take actions to try to avoid/reduce/share critical conditions through a systematic analysis of the potential risks.

3. Weather Risk Management in Tourism Industry

With reference to preventable and strategic risks, it is possible to obtain a detailed definition of them based on the features of the core business of a firm and on their relevance in pursuing and controlling the corporate objectives of a firm. With reference to external risks, such a detailed definition is harder, therefore actions and consequent control systems are required to reduce their negative impacts.

An example of external risks are weather risks, in particular rainfall risks. These risks are barely preventable. Tourism firms have little ability to influence and control the phenomenon of heavy rainfall, which causes economic damages (reduction in revenues and profitability), social damages (reduction of staff due to lack of work) and environmental damages (infrastructure breackdowns, etc.). Nonetheless, tourism firms will resort to develop actions aimed, firstly, at launching initiatives that limit the occurrence of such a risk by pursuing environmental performances in line with the objectives of 2030 Agenda for Sustainable Development of the United Nations. Secondly, tourism firms will share the risk through the provision of attractive additional services so as to encourage tourists to stay in summer holiday locations selected for their sun and their beaches. Finally, tourism firms will share the risk, especially to the goal of protecting their economic performances, through the adoption of financial instruments designed to hedge such a risk, like rainfall derivatives.

More specifically, tourism firms, such as hotels, could initiate the following complementary interventions:

- Launch, maintain, and develop a prevention strategy as a key factor of a policy for sustainable development to protect the environment and its deterioration. Well-designed and well-executed prevention strategies could favor sustainability by:

  - promoting environmentally friendly changes in production and consumption patterns;
  - determining the development of technologies that reduce the exploitation of natural resources and the related waste streams;
  - stimulating demand for goods and services with higher added value in environmental terms;
  - minimizing risks for human health and the environment;
  - promoting collaborative approaches and partnerships among stakeholders to achieve prevention goals.

  This should facilitate, for example, the reduction of energy consumption per capita by: the application of flow reducers and other technologies for saving water; the installation of energy-saving lamps; the change of towels on customer demand; the rationalization of external and common parts illumination; the choice of energy-saving domestic appliances, boilers, and air conditioners; energy-saving structural interventions to the building; production and use of renewable energy sources.
- Provide accessory services as a source of attractiveness for tourists to control their declining flows due to heavy rainfall, especially in the summer tourism destinations. For example, hotels could expand their core business with tasting events, sport activities, wellness centers, which promote tourism attractiveness safeguarding territory sustainability. This activity implies a deep knowledge of the relevant area and having tested the visiting, knowledge, amusement, tasting, and relaxing experiences that are recommended to guests, as well as continuing research on the territory to the goal of enhancing the integration with it at an architectural and landscape level. As the tourism firm expands its portfolio of products, thus becoming able to cover a larger share of the customer tourism experience, there are more chances to combat the negative effects of heavy rainfall.
- Use financial instruments to hedge weather risks. Typical hedging instruments of weather risks are insurance contracts. However, starting from the 90's new instruments have been introduced under the name of weather derivatives. Weather derivatives are better suited to hedge weather risks linked to "continuous events", like excess of rain or temperatures recorded over a month, whereas insurance contracts are better fit for "jump events", like hurricanes, storms, floods, and landslides. We will discuss about weather derivatives in Section 4, where we will also compare them to insurance contracts, focusing in particular on rainfall derivatives used by tourism firms. That of rainfall derivatives is a completely over-the-counter market, therefore its illiquidity is a major obstacle to their use by medium to small firms. Nevertheless, since they are financial instruments designed to hedge a volumetric risk, like the excess of rain, rainfall derivatives could contribute to an effective enterprise risk management. Indeed, such derivatives can be used together with traditional derivatives, which are typically devoted to hedge price risks, thus offering an additional, nearly independent from the other derivatives, way of covering enterprise risks.

4. Weather Derivatives and Rainfall Risk Management

A significant percentage of firms is weather-sensitive.[1] Think, for example, to the agriculture sector, to utilities using renewable energy sources, like sun, wind, and hydro, and to the tourism industry to mention but a few. The availability of instruments to hedge weather risks is essential for these firms. In general, a properly designed and implemented weather risk management is required in such cases. It has been found that such a management would not only preserve the firm value from losses due to weather-related damages, but also increase it (Pérez-González & Yun, 2013).

In this section, we would like to focus on a specific instrument of weather risk management, namely weather derivatives. They were introduced in the 90's and have spread ever since. Although the majority of weather derivatives are traded over-the-counter, standardized contracts have existed since 1999, when the first transactions took place at the Chicago Mercantile Exchange (CME) Group. They are second generation hedging instruments with respect to insurance contracts and compensate damages through mechanisms based on the performance of indices linked to climate variables, such as temperature, rainfall, snowfall, wind speed, and the like. Let us consider, for example, rainfall derivatives. They are designed to protect their buyers from excessive rainfall, which could negatively affect the firm operations in the medium to long run. An example of firms exposed to damages from too little rain could be agriculture firms: water is an important input of many processes in agriculture, and rain plays an important role in these processes. The lack of rain can seriously damage farming and breeding, therefore agricultural producers would greatly benefit from instruments to hedge such a risk (see, for example, Spicka & Hnilica, 2013). An example of firms exposed to damages from too much rain could be hotels: too much rain would lead to booking cancellations, in general it would keep customers away from the rainy tourism destinations, therefore hotels would incur into direct and indirect decreases of revenues. Again, it could be beneficial for hotels to adopt instruments designed to hedge the risk of significantly above the average rain. Excessive rain could also affect the operations of amusement firms like sports teams (see, for example and in the case of soccer teams in Japan, Ito et al., 2015). In the next section, we briefly compare the general class of weather derivatives to insurance contracts, whereas Section 4.2 focuses on rainfall derivatives used by the tourism industry.

4.1 Insurance Contracts Vs. Weather Derivatives

Weather derivatives show some remarkable differences with respect to insurance contracts, and we detail three of them in the following.

First, weather derivatives are based on an underlying, usually an index, which is owned by a third party, therefore neither the firm buying nor the financial institution issuing the derivative have the power to influence the calculation of the underlying values to the goal of making extra (unfair) profits with the derivative. This objective feature of weather derivatives is usually much weaker in the case of insurance contracts. Indeed, insurance contracts usually specify a third party, which is also known as adjuster, that is in charge of assessing the damaging consequences of

insured negative events. Whereas the underlying of a weather derivative is easily monitored, being typically represented by an analytical formula whose inputs are climate variable measurements available from public institutions, the assessment of the damaging consequences of negative events covered by the insurance contract can be a difficult task. Indeed, such an assessment often involves judgments by the adjuster, which are subjective *per se* and can be particularly hard if the insured firm adopts moral hazard behaviors.
Second, weather derivatives cover day-by-day risks, whereas insurance contracts are typically written on catastrophic natural events. Weather derivatives are designed to take into account risks exhibiting a "continuous" behavior, like, for example, the variations of heat, rain, and snow observed on monthly to yearly bases. Insurance contracts, on the other hand, are mostly based on "jump" risks, like, for example, the damaging effects of hurricanes, storms, floods, and landslides.
Third, the underlying of a weather derivative is usually an index based on climate variables that affect the firm operations in the medium to long run. Besides, these variables are measured by means of weather stations that are often placed far from the firm. On the contrary, insurance contracts are written to cover damages resulting from events that significantly affect the firm operations in the short run. Consequently, the hedging power of weather derivatives with respect to firm specific risks tends to be weaker than that of insurance contracts.

4.2 Rainfall Derivatives in Tourism Industry

Rainfall derivatives are designed to protect from excessive rainfall, and the tourism industry could be one of its main buyers (see the example at the beginning of the present section). In the following, we try to sketch the elements of a rainfall derivative: their structure, in Subsection 4.2.1, and the pricing of such derivatives, in Subsection 4.2.2.

4.2.1 Underlying, Payoff, and Parameters of a Rainfall Derivative

First, we will briefly discuss about the underlying of a rainfall derivative, then we will move to its payoff, i.e. the reward guaranteed to the buyer, and we will explain the meaning of the parameters used, together with the underlying, to calculate the payoff.
Typically, the underlying of a rainfall derivative is an index accumulating the amount of rain fell during a predefined period. Let us indicate with $r_{i,t}$ the amount of rain fell at place i and in time t. The rain is usually measured in millimeters. Let us consider a period composed by an agreed number T of consecutive times (typically weeks, days, hours). We can write the amount $R_{i,T}$ of rain fell in this period at place i as

$$R_{i,T} = \sum_{t=1}^{T} r_{i,t}. \quad (1)$$

A rainfall derivative payoff of interest to a tourism firm, like a hotel, could be the following:

$$P_{i,T} = \alpha \max(0; R_{i,T} - K), \quad (2)$$

where $R_{i,T}$ is defined in Eq. (1), K is the strike price, and α is the tick size. The structure of the payoff is simple: if $R_{i,T}$ is greater than K, i.e. the amount of rain fell in the period made of times $1, \dots, T$ is greater than the strike price, the hotel will be rewarded α monetary units, say dollars, for each millimeter of rain above K. The maximum function allows for a null payment in the case of a rainfall below K. The underlying $R_{i,T}$ and the two parameters K and α are set by the parties signing the contract. Typically, the underlying is agreed by the buyer and the seller of the derivative, but its calculation is done by a third party, whereas K and α are set by the hotel and the derivative issuer and are usually tailored to the specific needs of the hotel. Notice that also these two parameters would be set by a third party in the case of standard weather derivatives, i.e. derivatives traded on organized financial markets, like in the case of the futures and options traded at the CME Group.[2]

4.2.2 Pricing of Rainfall Derivatives

The pricing of rainfall derivatives is based on the no-arbitrage principle. This principle is a common sense principle, which people easily agree to consider when calculating prices.

However, problems arise with weather derivative pricing when the possibility of adopting an easier pricing framework called "risk-neutral pricing" is considered. Indeed, the no-arbitrage principle is equivalent to the existence of such an easier pricing framework and allows for prices to be calculated as if individuals were living in another (artificial) world. But in the case of weather derivatives (infinitely) many risk-neutral pricing frameworks exist, and it is not clear which of these frameworks should be adopted.

In many cases, weather derivative pricing is performed under a simplifying assumption: it is assumed that hotels live in a physical world that is risk-neutral, so there is no need to adopt a risk-neutral pricing framework, since it is already there.

Based on the previous assumption, we can write the (no-arbitrage) price $P_{i,0}$ at time 0 of a rainfall derivative with payoff $P_{i,T}$ at time T (see Eq. (2)) as

$$P_{i,0} = e^{-\delta T}\mathbb{E}(P_{i,T}), \tag{3}$$

where δ is the (instantaneously compounded) risk-free interest rate expressed in the same units of measurement of the T consecutive times making the life of the derivative and $\mathbb{E}(\cdot)$ is the expected value operator.

5. Conclusions

The tourism industry should take on a risk-prevention strategy as a pillar of a policy for sustainable development aimed at protecting the environment and its deterioration and at playing a key role in dealing with the challenges of climate change. At the same time, to mitigate the negative impacts of environmental risks, tourism firms should use financial instruments, like weather derivatives, that are designed to facilitate the hedging of such risks through the compensation of their consequent economic damages. Since the number of weather-sensitive firms is increasing as a consequence of a stronger climate change translating into an increasing variability of

weather, an understanding of weather derivative mechanics is of main importance for the survival of these firms. In addition, tourism firms should provide accessory services as a source of attractiveness for tourists.

Therefore, a proper risk management of tourism firms is important in order to make a significant contribution to sustainable development. To this purpose, the tourism industry should move towards a fair balance between economic growth and consumption of natural resources, to the final purpose of a better quality of life.

Bibliography

Ballou, B., & Heitger, D. L. (2005). A Building-Block Approach for Implementing COSO's Enterprise Risk Management – Integrated Framework. *Management Accounting Quarterly*, *6*(2), 1-10.

Barrios, S., & Ibañez, J. N. (2015). Time Is of the Essence: Adaptation of Tourism Demand to Climate Change in Europe. *Climatic Change*, *132*(4), 645-660. http://dx.doi.org/10.1007/s10584-015-1431-1

Bowling, D.M., & Rieger, L. A. (2005a). Making Sense of COSO's New Framework for Enterprise Risk Management. *Bank Accounting & Finance*, *18*(2), 29-34.

Bowling, D.M., & Rieger L. (2005b). Success Factors for Implementing Enterprise Risk Management. *Bank Accounting & Finance*, *18*(3), 21-26.

Brondoni, S. M. (2009). Market-Driven Management, Competitive Customer Value and Global Network. *Symphonya. Emerging Issues in Management*, 1, 8-25. http://dx.doi.org/10.4468/2009.1.02brondoni

Brondoni, S. M. (2014). Global Capitalism and Sustainable Growth. From Global Products to Network Globalisation. *Symphonya. Emerging Issues in Management*, 1, 10-31. http://dx.doi.org/10.4468/2014.1.02brondoni

COSO (2004). *Enterprise risk management – Integrated framework*. Durham, NC, USA: American Institute of Certified Pubblic Accountants (AICPA).

Faris, C., Gilbert, B., LeBlanc, B., Ballou, B., & Heitger, D. L. (2013). *Demystifying Sustainability Risk. Integrating the triple bottom line into an enterprise risk management program*. The Committee of Sponsoring Organizations of the Treadway Commission (COSO).

Franzoni, S. (2015). Measuring the Sustainability Performance of the Tourism Sector. *Tourism Management Perspectives*, 16, 22-27. http://dx.doi.org/10.1016/j.tmp.2015.05.007

Ito, H., Ai, J., & Ozawa, A. (2015). Managing Weather Risks: The Case of J. League Soccer Teams in Japan. *The Journal of Risk and Insurance*. http://dx.doi.org/10.1111/jori.12071

Kaplan, R. S., & Mikes A. (2012). Managing Risks: A New Framework. *Harvard Business Review*, *90*(6), 48-60.

Landsittel, D. L., & Rittenberg, L. E. (2010). COSO: Working with the Academic Community. *Accounting Horizons*, *24*(3), 455-469. http://dx.doi.org/10.2308/acch.2010.24.3.455

Leiper, N. (1990). *Tourism systems*. Palmerston North, New Zealand: Dept. of Management Systems, Business Studies Faculty, Massey University.

Moeller, R. R. (2007). *COSO enterprise risk management. Understanding the new integrated ERM framework*. Hoboken, NJ, USA: John Wiley & Sons.

Njoroge, J. M. (2015). Climate Change and Tourism Adaptation: Literature Review. *Tourism and Hospitality Management*, 21(1), 95-108.

Pérez-González, F., & Yun, H. (2013). Risk Management and Firm Value: Evidence from Weather Derivatives. *The Journal of Finance*, *68*(5), 2143-2176. http://dx.doi.org/10.1111/jofi.12061

Quinn, L. R. (2006). COSO at a Crossroad. *Strategic Finance*, *88*(1), 42-49.

Salvioni, D. M. (2012). Governance, Risk Management and Business Effectiveness in Global Firm. In D. Tipurić, & M. Dabić (Eds.), *Management, governance, and entrepreneurship – New perspectives and challenges* (pp. 300-313). Darwen, UK: Access Press UK.

Salvioni, D. M., & Astori, R. (2013). Sustainable Development and Global Responsibility in Corporate Governance. *Symphonya. Emerging Issues in Management*, (1), 28-52. http://dx.doi.org/10.4468/2013.1.03salvioni.astori

Simpson, M. C., Gössling, S., Scott, D., Hall, C. M., & Gladin, E. (2008). *Climate change adaptation and mitigation in the tourism sector: Frameworks, tools and practices*. Paris, France: UNEP, University of Oxford, UNWTO, WMO.

Spangenberg, J. H., & Bonniot, O. (1998). *Sustainability indicators: A compass on the road towards sustainability – Wuppertal Paper no. 81, February 1998*. Wuppertal, Germany: Wuppertal Institut für Klima, Umwelt, Energie GmbH.

Spicka, J., & Hnilica, J. (2013). A Methodical Approach to Design and Valuation of Weather Derivatives in Agriculture. *Advances in Meteorology*, *2013*(146036), 8 pages. http://dx.doi.org/10.1155/2013/146036

United Nations (2015). *Transforming our world: The 2030 agenda for sustainable development - A/RES/70/1*. New York, NY, USA: United Nations.

UNWTO (2015). *Tourism and the sustainable development goals*. Madrid, Spain: World Tourism Organisation.

Notes

[1] One third worldwide, according to the Chicago Mercantile Exchange (CME) Group web page http://www.cmegroup.com/trading/weather/.

[2] See the CME Group web page http://www.cmegroup.com/trading/weather/.